

## Natural Microbe Seeding (Bioaugmentation)

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**Objective:** A form of bioremediation used to accelerate natural microbial degradation of oil by adding high numbers of oil-degrading microorganisms.

**Description:** Formulations containing specific hydrocarbon-degrading microbes are added to the oiled area because there are few indigenous hydrocarbon degraders, or those that are present cannot degrade the oil effectively. Since microbes require nitrogen and phosphorus to convert hydrocarbons to biomass, formulations containing these oil degraders must also contain adequate nutrients. Research studies conducted with bioengineered organisms or organisms enriched from different environments, grown in the laboratory to high numbers, and applied to an oiled beach to stimulate rapid biodegradation, have failed to prove conclusively that seeding is effective.

Bioaugmentation appears less effective than biostimulation because: 1) hydrocarbon degraders are ubiquitous in nature and, when an oil spill occurs, the influx of oil will cause an immediate increased response in the hydrocarbon-degrading populations; but, 2) if nutrients are in limited supply, the rate of oil biodegradation will be less than optimal; thus, 3) supplying nutrients will enhance the process initiated by the spill, but adding microorganisms will not, because they still lack the necessary nitrogen and phosphorus to support growth.

The maximum number of microbial organisms achievable will determine the maximum biodegradation rate. If nutrient supplementation is sufficient to maximize that rate, bioaugmentation will not further increase the biodegradation rate.

## Natural Microbe Seeding (Bioaugmentation) (cont.)

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Applicable Habitat Types:	There is insufficient information on impacts or effectiveness of this method to make a judgment on applicable habitat.
When to Use:	There is insufficient information on impacts or effectiveness of this method to make a judgment on when to use it.
Biological Constraints:	Avoid using products containing ammonia-based fertilizers at elevated concentrations because un-ionized ammonia is toxic to aquatic life. Nitrate is an equally good nitrogen source, minus the toxicity. If the product containing nutrients is applied properly with adequate monitoring, eutrophication should not be a problem, but toxicity tests should be evaluated carefully, as other chemicals in the product could be toxic to aquatic organisms.
Environmental Effects:	Detrimental physical effects to shoreline from foot or vehicle traffic caused by workers applying bioaugmentation products (unless nutrients are sprayed from a vessel or aircraft).
Waste Generation:	None.